CONCISE COMMUNICATION

Impact of an Antimicrobial Stewardship Care Bundle to Improve the Management of Patients with Suspected or Confirmed Urinary Tract Infection

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Implementation of an antimicrobial stewardship program bundle for urinary tract infections among 92 patients led to a higher rate of discontinuation of therapy for asymptomatic bacteriuria (52.4% vs 12.5%; $P = .004$), more appropriate durations of therapy (88.7% vs 63.6%; $P = .001$), and significantly higher overall bundle compliance (75% vs 38.2%; $P < .001$).

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The Centers for Disease Control and Prevention (CDC) Core Elements for Hospital Antimicrobial Stewardship Programs (ASPs) recommend the development and implementation of infection specific interventions to improve prescribing for common infections.[1] Urinary tract infections (UTIs) are among the most common infections in hospitalized patients; however, data are limited regarding ASP strategies to effectively manage confirmed or suspected UTIs. One recent analysis found that 61% of patients with a positive urine culture had asymptomatic bacteriuria (ASB) and that 64% of those were inappropriately treated with antimicrobials for a mean duration of 9.1 days.[2] The aim of our study was to investigate the use of an ASP-driven comprehensive care bundle for the treatment of confirmed or suspected UTIs.

METHODS

Institutional guidelines for the treatment of UTIs were developed in 2012 and are available for reference on pocket cards and the ASP intranet. The guideline development process followed a review of published national and professional society guidelines and consensus statements.[2–6] Contained within the guidelines are criteria for sending a urine culture and when to treat a patient based on clinical symptoms, along with antimicrobial choice and duration of therapy recommendations based on clinical scenarios including uncomplicated and complicated lower tract UTIs, pyelonephritis, and sepsis with UTI.[3] Rollout of the guidelines was accompanied by an educational campaign targeting the medicine hospitalist group at our 537-bed community teaching hospital.

A pharmacist-driven UTI care bundle was implemented in June 2014. A real-time alert was built in our clinical surveillance system Sentri7 (Pharmacy OneSource, Bellevue WA) to identify patients receiving antimicrobial therapy with organisms identified on urine culture or a urinalysis showing pyuria (white blood cell count > 0), positive leukocyte esterase, or positive nitrites. The alert prompted clinical pharmacists in respective patient care areas to review a series of questions assessing patient compliance with individual elements of the institutional criteria. Pharmacist follow-up and documentation of review and feedback discussions with prescribers were encouraged.

This single-center, quasi-experimental study evaluated bundle compliance among patients with suspected UTIs compared to historic controls. All adult patients identified by the clinical decision support software UTI bundle alert were included. The study design included 2 study periods: a historical control period (April 2014) prior to bundle implementation, and an AST intervention period (July 2014). Exclusion criteria included patients who were provided comfort care within 48 hours, patients with concomitant infections, pregnancy, planned urologic procedures, complex urinary anatomy (ie, nephrostomy tubes, urinary tract stents), neutropenia (absolute neutrophil count <1,000/mL), and those with a UTI bundle alert active <48 hours. The study was approved by the institutional review board.

The primary study outcome was an overall bundle composite, defined as compliance with all individual bundle elements, which included the following criteria. (1) Only patients with confirmed UTIs received treatment following ASP review. A UTI was defined as the presence of any of the following clinical criteria without an alternative explanation: urgency, frequency, dysuria, suprapubic pain/tenderness, flank pain or tenderness, new onset delirium, fever/rigors >38°C, acute hematuria, or increased spasticity or autonomic dysreflexia in a patient with spinal cord injury.[2–6] (2) Empiric antimicrobial therapy was appropriate if the initial agent of choice matched institutional guidelines or a therapy change to an approved empiric agent occurred within 48 hours and before urine culture and susceptibility data returned. (3) If an organism was identified on urine culture, the optimal agent, if not empirically chosen, was selected according to institutional guidelines within 48 hours. (4) Intravenous (i.v.) therapy was changed to oral therapy (p.o.) within 72 hours according to the institutional i.v. to p.o. policy; (5) The combined inpatient and discharge duration matched institutional recommendations.

Statistical analysis was performed using SAS 9.3 (SAS Institute, Cary, NC) and MS Excel 2010 (Redmond, WA) and was evaluated at a significance level of 0.05. A linear regression model with a logit link function was fit for UTI-related readmission as the dependent variable, as well as models with the identity link for the total cost of hospitalization, length of stay

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(LOS), and course of therapy (UTI and non-UTI) as the dependent variables. Backward selection was used to determine model fit until only those with a significance level ≤0.05 remained.

RESULTS

In the historical group, 157 patients were identified. Among them, 89 patients (57%) were excluded: 85 had concomitant infections, 2 were pregnant, and 2 were provided comfort care. The bundle group included 146 patients. Among these patients, 54 patients (37%) were excluded: 53 had concomitant infection and 1 was pregnant. No differences in demographic characteristics were detected between the groups (Table 1).

Patients who met our composite endpoint (ie, compliance with all bundle elements) were significantly higher in the bundle group (75% vs 38.2%; $P < .001$) (Table 2). Patients who received appropriate durations of therapy also significantly improved following bundle implementation (88.7% vs 63.6%; $P = .001$). Bundle implementation led to a higher rate of discontinuation of therapy for ASB (52.4% vs 12.5%; $P = .004$). The average antimicrobial duration in patients with ASB was lower in the bundle group (2.3 vs 4.9 days; $P = < .001$), leading to 65 less antibiotic days between groups (51 post-bundle vs 116 pre-bundle). There were no significant differences in the rates of de-escalation, change to oral therapy, percentage of patients started on appropriate initial therapy, UTI-related readmissions, average length of stay, and total hospitalization cost.

DISCUSSION

Implementation of a care bundle for patients with suspected UTIs led to significant increases in discontinuation of treatment for ASB (52.4% vs 12.5%; $P = .004$), improved durations of therapy (88.7% vs 63.6%; $P = .001$), and overall bundle compliance. Overall, 75% of patients met all bundle elements following implementation of the UTI bundle compared with 38.2% of historical controls. Results of our analysis are consistent with previous studies, which have routinely revealed the overtreatment of ASB at baseline and improvements in process measures or outcome variables following implementation of a targeted intervention. For example, Hermainides et al[7] identified and validated guideline-based quality indicators for the treatment of complicated urinary tract infections. Spoorenberg et al[8] investigated 4 of those quality indicators and found that

TABLE 1. Study Population Characteristics for Historical Group and Urinary Tract Infection Bundle Group

Variable	Historical Group (n = 68), No. (%)	UTI Bundle Group (n = 92), No. (%)	*P* Value
Female	44 (64.7)	54 (58.7)	.44
White	64 (94.1)	74 (80.4)	.01
ICU stay	10 (14.7)	18 (19.6)	.42
Charlson Comorbidity Index score, median (IQR)	1 (1–3)	2 (1–3)	.23
Mortality within 30 d of discharge	4 (5.9)	4 (4.4)	.72[a]
UTI mortality within 30 d of discharge	0	0	…
Inpatient readmission within 30 d of discharge	10 (14.7)	13 (14.1)	.92
Inpatient readmission within 30 d of discharge due to UTI	2 (2.9)	4 (4.4)	.99[a]
Development of CDI	2 (2.9)	2 (2.2)	.99[a]
Mean length of stay	6.3 d	9.6 d	.29
Total hospitalization cost	$18,681	$14,680	.77

NOTE. CDI, *Clostridium difficile* infection; UTI, urinary tract infection; ICU, intensive care unit; IQR, interquartile range.
[a]Evaluation by Fisher's exact test. Otherwise, normally distributed continuous data were compared using a 2-sample Z test of means, while categorical data were compared using a Wald χ^2 test of independence.

TABLE 2. Analysis of Compliance with Elements of the Urinary Tract Infection Management Bundle

Bundle Element	Historical Group (n = 68), No. (%)	UTI Bundle Group (n = 92), No. (%)	*P* Value
Compliance with overall bundle elements	26 (38.2)	69 (75)	<.001
Discontinuation of treatment for asymptomatic bacteriuria	3/24 (12.5)	11/21 (52.4)	.004
Change to appropriate empiric therapy	46 (67.6)	71 (77.2)	.18
De-escalate antimicrobial when susceptibilities available	36/42 (85.7)	47/50 (94)	.18
Therapy change to oral antimicrobial	37/39 (94.9)	37/42 (88.1)	.28
Appropriate duration of therapy[a]	28/44 (63.6)	63/71 (88.7)	.001

NOTE. UTI, urinary tract infection.
[a]Duration of therapy in patients receiving treatment for asymptomatic bacteriuria was not included in final endpoint.

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2 of them (ie, adherence to local guidelines and a safe, early switch to oral antibiotics) lowered the length of hospital stay. Other strategies have included the use of significant prescriber educational campaigns and discouraging routine reporting of positive noncatheterized urine culture results.[3,9,10]

Our analysis has several limitations. Determination of whether a patient met criteria for treatment relied on prescriber documentation in the medical record. Patients may have experienced unreported UTI-related symptoms known to the prescriber at the time of treatment, yet not apparent to the pharmacist during review. In essence, this uncertainty mimics the initial review process utilized by many pharmacists and ASPs. Bundle implementation helped ameliorate this limitation by facilitating real-time goal-directed communication, leading to a decreased rate of inappropriate treatment. Another limitation is that our clinical outcome variables may not have been statistically powered to show meaningful differences between groups.

Implementation of our UTI bundle improved the management of patients with confirmed or suspected UTIs. Our bundle combined a multifaceted group of interventions with the use of ASP and pharmacist involvement, providing further support for the use of ASP-directed evidence-based interventions to enhance the management for various infectious disease states.

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